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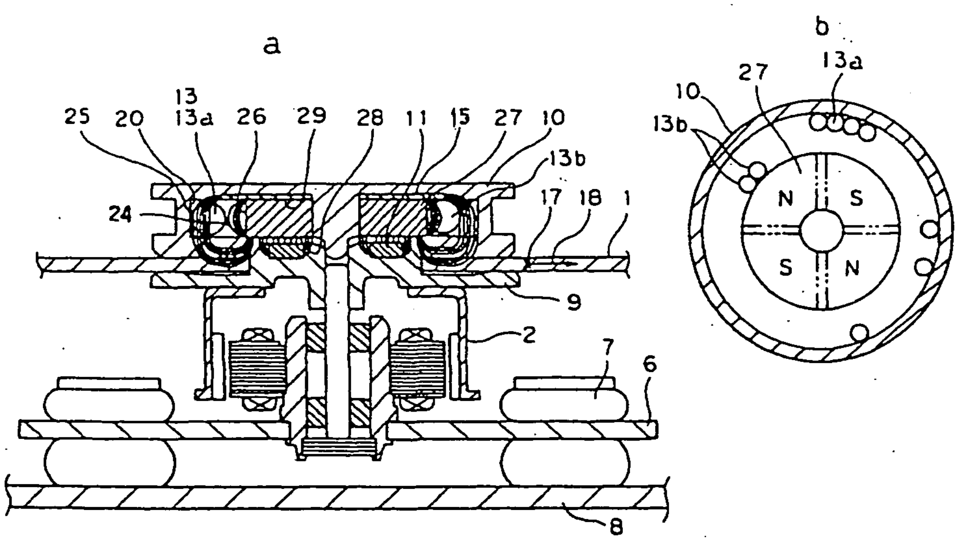

(57) Abstract

In an art of canceling the unbalance of a disk by utilizing globes, the present invention provides a disk apparatus which can efficiently cancel the unbalance, and prevent the occurrence of unnecessary noises, and further, does not induce the occurrence of errors when the speed is shifted or when the spinning-up is made. In a disk apparatus which comprises a subbase (6), a main base (8), and a turn table (9), and further a balancer including members such as a magnet (27) and globes (13), and is to cancel the unbalance of a disk (1) by utilizing movements of the globes (13), an improvement wherein the magnet (27), which a clamper (10) contains to hold the disk (1), is magnetized by polarization into four or more poles in a rotational direction or by polarization in a direction of a rotational axis or in a radial direction.

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DESCRIPTION

Disk Apparatus

TECHNICAL FIELD

The present invention relates to a disk apparatus which has a vibration-suppressing unit for suppressing the self-vibration due to unbalance of a disk as a recording medium, and enables stable recording and replaying.

BACKGROUND ART

In recent years, the data-transferring speed of disk apparatuses, which record and replay data, such as CD-ROM drives and CD-R drives, is getting faster and faster. The high-speed data transferring needs high-speed disk rotation. Many of conventional disks are unbalanced disks which have a bias in mass balance due to factors such as their thickness unevenness. The rotation of such disks at a high speed has problems, for examples, as follows: the self-vibration of the disks is caused by their unbalance force and transmitted to the whole apparatus, so the data cannot stably be replayed, or the vibration make noises or shorten the span of life of the motor, and further, when there is a drive unit inside a computer, the vibration is transmitted to peripheral instruments to give bad influences to them. Therefore, the high-speed data transferring by the high-speed disk rotation needs the suppression of the self-vibration due to unbalance of the disk. Thus, various measures are taken to cancel the unbalance.

Hereinafter, an explanation is made on a conventional disk apparatus which has a function to cancel the unbalance.

Fig. 7 is a perspective of a disk apparatus as provided with a balancer to cancel the unbalance. The number "1" symbolizes a disk, which is placed on a turn table 9 and rotarily driven with a spindle motor 2. A light-pickup 3 reads data as recorded on the disk 1, or writes data onto the disk 1. The rotation of a light-pickup driving motor 4 is converted into a linear movement by function of a light-pickup driving system 5, whereby the light-pickup 3 is frictionally moved in a radial direction of the disk 1. These mechanical systems above are all mounted on a subbase 6, which is connected to a main base 8 through an elastic insulator 7 of low stiffness wherein the insulator 7 attenuates the vibration as transmitted from outside. The disk 1 is rotated by being interposed between the turn table 9 and a clamper 10, both of which rotate in one body with the spindle motor 2. The resonance frequency of the vibration of the subbase 6 due to the deformation of the insulator 7 during the high-speed rotation of the disk 1 is set to lower than the frequency of the high-speed rotation of the disk 1.

Fig. 8 is a section of the vicinity of the spindle motor 2, showing details of a balancer as fitted in one body with the clamper 10 of the above disk apparatus. A yoke 11, which is a magnetic matter and is made of a metal, is fixed on the turn table 9 so as to be rotated in one body with the spindle motor 2. The clamper 10 contains a magnet 27, and the disk 1 is interposed by magnetic adsorbing force of magnetic flux, as generated between the magnet 27 and the yoke 11, so that the disk 1 can be rotated in one body therewith. Usually, the magnetized face 28 of the magnet 27 is magnetized in dipole in view of both the easiness in the production process and the simple usage. The number "15" is a back yoke of a metallic magnetic matter and is fixed by adsorption onto an

unmagnetized face 29 of the magnet 27 to intercept magnetic flux as leaked from other than the magnetized face 28, thus enhancing the efficiency of the sucking force to the disk 1. The clamper 10 contains at least two magnetic globes 13 possible to tumble. The numbers "13a" and "13b" symbolize positions of the globes 13 during the high-speed rotation and during the low-speed rotation respectively, being shown separately into right and left portions of the drawing figure. These balancer-constituting parts are mounted on the subbase 6, which is connected to the main base 8 through the insulator 7. As is aforementioned, the resonance frequency of the vibration of the subbase 6 due to the deformation of the insulator 7 during the high-speed rotation of the disk 1 is set to lower than the frequency of the high-speed rotation of the disk 1.

Fig. 9 is a view showing that the unbalance is canceled during the high-speed rotation of the disk by the movements of the globes 13 as provided inside the clamper 10, and this fig. is a section of the clamper 10 as viewed from upward.

Referring to Fig. 8 and Fig. 9, explanations are made about the condition of the globes 13 during the low-speed rotation of the unbalanced disk 1, and about the cancellation of the unbalance of the disk 1 during the high-speed rotation thereof.

As to the CD-ROM drive, the disk 1 is usually rotated at a high speed (about 4,200 rpm at maximum in the 8-time speed mode) to achieve a fast data-transferring speed when reading data. On the other hand, for example, as to the audio play, the disk is usually rotated at a standard speed (about 200~500 rpm). Thus, there coexist the high-speed rotation area, such as data read, and the low-speed rotation area, such as audio

play.

When the disk 1 with unbalance is rotated on its own axis at a high speed, the unbalance force 18 that is the centrifugal force operates upon the gravity center 17 of the disk 1, and its operating direction rotates along with the disk 1. This unbalance force 18 deforms the insulator 7 to cause the subbase 6 to rotate while swinging at a rotational frequency of the disk 1. Because, as is aforementioned, the resonance frequency of the vibration of the subbase 6 is set to lower than the rotational frequency of the disk 1, the direction of the displacement of the subbase 6 is always opposite to the direction of the unbalance force. Therefore, upon the at least two globes 13 as provided inside the clamper 10 so as to be tumbled, there operates the movement force 22 that is the resultant of the centrifugal force 19 with the resistant force 21 from a tumbling face 20 where the globes 13 are pressed to be tumbled. As a result, the globes 13 moves in a direction getting away from the swinging-rotation center 23, and assemble in a direction opposite to the direction of the unbalance force 18, and finally, the amount of the unbalance of the disk 1 is canceled owing to the total mass of the assembled globes 13a.

On the other hand, in the low-speed rotation area such as standard speed, the centrifugal force 19 of the globes 13 is so insufficient that the globes 13 are not pressed to the tumbling face 20, and the placing of the globes 13 therefore becomes unstable, thus making unnecessary noises, such as tumbling sounds of the globes 13, frictional movement sounds between the globe 13 and an inner-face part of the clamper 10, and sounds of collision between the globes 13. To prevent them, the globes 13 are made of metallic magnetic matters. Furthermore, the leaked magnetic flux 24 of the magnet 27, or the magnetic flux 25 from the magnetized face

28 to the back yoke 15, is utilized to allow the outer periphery 26 of the magnet 27 or the back yoke 15 to directly adsorb the globes 13 to stabilize their placing in the positions of the globes 13b, thus preventing the occurrence of the above unnecessary noises.

However, the above constitution has the below-mentioned problems when the rotation of the disk 1 is rapidly shifted from the high-speed rotation to the low-speed rotation.

As to some of CD-ROM disks, generally, there coexist data and audio in a disk. When such a disk is replayed, there occurs a pattern in which just after reading data at a high speed, the number of rotations is dropped to the standard one to replay the audio. That is to say, the disk is rapidly shifted to a low speed when being rotated at a high speed, and just thereafter, the audio play must be carried out.

As is aforementioned, during the high speed, the globes 13 are rotated in one body with the clamper 10 while being pressed to the tumbling face 20 to cancel the unbalance of the disk 1. However, when the number of rotations drops to a predetermined one, the centrifugal force to operate upon the globes 13 is so insufficient that the globes 13 are adsorbed by the outer periphery 26 of the magnet 27 or by the back yoke 15 due to the function of the leaked magnetic flux 24 of the magnet 27 or the function of the magnetic flux 25 from the magnetized face 28 to the back yoke 15. However, as is aforementioned, the magnetized face 28 of the magnet 27 are magnetized in dipole. In the case of this dipole magnetization, there are characteristics in that the leaked magnetic flux 24 is large, while the magnetic flux density of the magnetic flux 25 is small. Therefore, when the disk 1 is shifted from the low-speed rotation to the high-speed rotation, the globes 13 are difficult to separate from the

outer periphery 26 of the magnet 27. Inversely, when the disk 1 is shifted from the high-speed rotation to the low-speed rotation, the outer periphery 26 of the magnet 27 is difficult to adsorb the globes 13, because the globes 13 do not separate from the tumbling face 20 unless the centrifugal force 19 to operate upon the globes 13 becomes considerably small. When, as is aforementioned, the disk is shifted to the audio play just after reading data by high-speed rotation, the globes 13 are adsorbed by the outer periphery 26 of the magnet 27 after the initiation of the audio data reading, because of the above characteristics of the difficulty in separation and adsorption of the globes 13. The impact during this adsorption is transmitted to the disk 1, thus causing the induction of read errors.

In addition, during the rotation initiation, namely, the spinning-up, of the disk, the globes separate from the magnet to collide with the tumbling face after the number of rotations becomes sufficiently high, because there are characteristics in that, due to the function of the great leaked magnetic flux 24, the globes 13 are difficult to separate from the outer periphery 26 of the magnet 27. Therefore, the resultant impact is great and therefore causes induction of defects such as spinning-up time over.

DISCLOSURE OF THE INVENTION

OBJECT OF THE INVENTION

Considering the above-mentioned problems, an object of the present invention is to provide a disk apparatus which efficiently cancels the unbalance of the disk by utilizing the centrifugal force of the globes during the high-speed rotation (which involves the problems of the unbalance of the disk), and prevents the occurrence of the unnecessary

noises by stabilizing the placing of the globes during the low-speed rotation like audio play, and further, does not induce the occurrence of errors when the number of rotations of the disk is rapidly shifted from the high-speed rotation to the low-speed read or when the spinning-up is made.

SUMMARY OF THE INVENTION

To solve the above problems, a disk apparatus according to the present invention comprises: a balancer as a means of efficiently canceling the unbalance of the disk, which balancer is set to rotate in one body with a fitted disk and has a hollow ring-shaped part containing a magnetic matter; and a magnetic-field-generating means for holding the magnetic matter by suction. This disk apparatus further comprises at least one of the following constitutions (1) to (3):

(1) that the magnetic-field-generating means is a magnet which is placed on the inner peripheral side of the hollow ring-shaped part and is magnetized by polarization into four or more poles in a rotational direction;

(2) that the magnetic-field-generating means is a magnet which is placed on the inner peripheral side of the hollow ring-shaped part and is magnetized by polarization in a direction of a rotational axis;

(3) that the magnetic-field-generating means is a magnet which is placed on the inner peripheral side of the hollow ring-shaped part and is magnetized by polarization in a radial direction.

In the present invention, the magnet, used as the magnetic-field-generating means, is a magnetized one by polarization into four or more poles in a rotational direction, or by polarization in a direction of a rotational axis, or by polarization in a radial direction, so the influence of

the leaked magnetic flux, which the magnetic matter suffers from the magnet, reduces to efficiently cancel the unbalance of the disk. In the present invention, even in the case where during the low-speed rotation of the disk the centrifugal force to operate upon the magnetic matter is so small as to cause unstable movements of the magnetic matter due to the leaked magnetic flux of the magnet, the magnetic matter is so difficult to suffer the influence of the leaked magnetic flux that the unbalance force of the disk can stably be canceled.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, some of the embodiments of the present invention are explained while referring to the drawings. Incidentally, as to the constitution of each embodiment below, the same components as those of the aforementioned conventional apparatuses are given the same numbers as those for the conventional apparatuses.

(Quadrupole magnetization):

Fig. 1 shows a first embodiment of the present invention, in which Fig. 1a is a section, and Fig. 1b is a plan of the magnet.

The number "13" is a globe of a metallic magnetic matter, a plurality of which are placed in the clamper 10 so that they can be tumbled to cancel the unbalance of the disk 1. The number "13a" shows a position of a globe 13 in a high-speed rotation, and the number "13b" shows a position of the globe 13 in a low-speed rotation and at a stop. The number "27" is a magnet, of which the magnetized face 28 is magnetized by quadruple polarization, and the disk 1 is interposed between the magnet 27 and the turn table 9 by forming a magnetic path toward the yoke 11 and thus sucking the yoke 11. In Fig. 9 showing the aforementioned structure of dipole magnetization, the circumference of

the magnet 27 is divided into an S pole and an N pole by 180° each. On the other hand, as to the quadrupole magnetization as shown in Fig. 1b, S poles and N poles are alternately arranged by division totally into four poles of 90° each in a circumferential direction. The magnetic suction force of the magnet 27 upon the yoke 11 is set to the same as that of the dipole magnetization. The number "15" is a back yoke and is fixed by adsorption onto an unmagnetized face 29 of the magnet 27, and the outer diameter of the back yoke is designed to be sufficiently larger than that of the magnet 27. The number "24" stands for the magnetic flux as leaked from the magnet 27, and the number "25" stands for the magnetic flux from the magnetized face 28 to the back yoke 15.

As to the first embodiment of the present invention with the above constitution, explanations are made about what mechanism is made when the disk 1 is rotated at a high or low speed.

Similarly to the aforementioned conventional disk apparatus as shown in Fig. 9, if the disk 1 exhibiting unbalance during the high-speed rotation such as data reading is rotated, the centrifugal force 19 from the swinging-rotation center operates upon the globes 13, whereby the globes 13 are pressed onto the tumbling face 20 to move while tumbling, and then assembles in a direction opposite to the unbalance direction of the disk 1 to stop where balanced with the unbalance force, and then rotates in one body with the clamper 10, whereby the unbalance of the disk 1 is canceled.

On the other hand, when the rotation of the disk 1 is shifted from the high speed to the low speed like the audio play, the centrifugal force 19 to operate upon the globes 13 becomes so insufficient that the globes 13 separate from the tumbling face 20 and are then adsorbed by the outer

periphery 26 of the magnet 27 or by the back yoke 15 due to the function of the leaked magnetic flux 24 of the magnet 27 or the function of the magnetic flux 25 from the magnet 27 to the back yoke 15.

Incidentally, as to the above embodiment, because the magnetized face 28 of the magnet 27 is magnetized in quadrupole, the state of the magnetic flux is such where: in comparison with the case of the dipole magnetization, the leaked magnetic flux 24 in the vicinity of the outer periphery 26 of the magnet 27 is much less, and the magnetic flux density of the magnetic flux 25 from the magnetized face 28 to the back yoke 15 is greater. As a result, the movement of the globes 13 is such that the globes 13 are easier to separate from or be adsorbed by the magnet 27 in comparison with the case of the dipole magnetization. When the rotation of the disk 1 is rapidly dropped from the high speed to the low speed, the above properties enable the globes 13 to be adsorbed by the magnet 27 in fast timing. That is to say, because the globes 13 are adsorbed before the shift to the audio data reading mode, no data-reading error occurs due to the impact as made during the adsorption of the globes 13. In addition, because the leaked magnetic flux 24 is also small, the adsorption of the globes 13 causes little impact.

In addition, when the spinning-up is made, the globes 13 are so easy to separate from the magnet 27 that they can separate therefrom in fast timing, and the impact due to their collision with the tumbling face is much less than that in the case of the dipole magnetization. Thus, error-inducing factors such as servo slipping can largely be reduced.

Fig. 2 shows graphs to demonstrate the function of the first embodiment. The upper graph (A) in this figure shows the properties in the case of using the balancer utilizing the quadrupole-magnetized

magnet according to the above embodiment, and the lower graph (B) in the figure shows the properties in the case of using the conventional balancer utilizing the dipole-magnetized magnet. In each graph, the number "33" shows a starting point of a data reading (Read Signal) for the audio, and the number "34" shows the violence of a tracking error signal (Tracking Error Signal) as caused by the collision of the globes 13 with the magnet 27. The number "35" shows a voltage variation of the spindle motor 2 (Spindle Motor V_M Signal), and the falling portion of this variation 35 shows a shifting period from the high speed to the low speed. The positioning relations between these numbers 33, 34, and 35 will help to understand the timing relations between the collision time of the globes 13 with the magnet 27 and the read-starting point of audio data in the case where the number of rotations of the disk 1 rapidly changes.

The comparison of graphs (A) and (B) of Fig 2 with each other demonstrates as follows. As to the dipole-magnetized balancer of graph (B), during the rapid shifting from the high speed to the low speed, the timing of adsorption of the globes 13 by the magnet 27 is so slow that the globes 13 collide with the magnet 27 later than the data read starts. Therefore, the tracking error signal, which is a factor of inducing the occurrence of errors in the audio data replay mode, is made very violently. On the other hand, as to the quadrupole-magnetized balancer of graph (A), the globes 13 separate from the tumbling face 20 at the same time as the shift of the rotation of the disk 1 from the high speed to the low speed, and are then adsorbed by the magnet 27. The violence of the tracking error signal therefore occurs before the audio data read starts, so no error occurs.

(Magnetization by polarization in axial or radial direction):

Figs. 3~6 show a second and a third embodiment of the present invention. The structures common to the aforementioned embodiment are given the same symbols as those of the aforementioned embodiment, and the overlapping detailed explanations are omitted.

As to the embodiment of Fig. 3, at least two globes 13 are set to tumble in the clamper 10. The number "13a" symbolizes a position of the globes 13 during the high- or low-speed rotation, while the number "13b" symbolizes a position of the globes 13 in the stop mode. The whole of the magnetized face 28 of the magnet 27 is polarized into the same pole (S pole in the figure), while the whole of the unmagnetized face 29 is polarized into the pole (N pole) that is inverse to the magnetized face 28. In other words, the magnet 27 is magnetized by polarization in a vertical rotation-axial direction of the clamper 10. As a result, a magnetic path toward the yoke 11 is formed to suck the yoke 11, whereby the disk 1 is interposed between the magnet 27 and the turn table 9. The magnetic suction force of the magnet 27 upon the yoke 11 is set to the same as that of the dipole magnetization. The number "24" symbolizes the leaked magnetic flux from the magnet 27.

As to the embodiment of Figs. 4~6, the magnet 27 is magnetized by polarization in a radial direction. In the plane shape on the upper face side, namely, the unmagnetized face 29 side, of the magnet 27, as is shown in Fig. 5, an N pole and an S pole are concentrically distributed on the inner and outer peripheral sides respectively. As is schematically shown in Fig. 6a, the surface side and the back side of the magnet 27 are polarized inversely to each other. Therefore, it follows that an S pole and an N pole are concentrically distributed on the inner and outer peripheral sides, respectively, of the magnetized face 28. Incidentally, even if the S

pole and the N pole are inversely distributed as shown in Fig. 6b, the same function is achieved.

When the magnet 27 is polarized in an axial or radial direction in the above way, the leaked magnetic flux 24 in the vicinity of the tumbling face 20 of the magnet 27 is very little. Therefore, the globes 13 hardly suffer influence from the leaked magnetic flux even in the case of the centrifugal force reduction, so the unbalance can be canceled similarly to the case of the high speed rotation. In addition, during the spinning-up, the globes 13 begin to tumble on the tumbling face 20 in so fast timing that the impact due to the collision of the globes 13 with the tumbling face is much less than that in the case of the dipole magnetization. Therefore, error-inducing factors such as servo slipping can largely be reduced.

Fig. 10 shows influences, which the dipole-magnetized magnet 27 gives the globes 13, with regard to a conventional disk apparatus. When a disk, displaying the unbalance in a low-speed rotation, such as DVD twice-fast speed, is rotated (Fig. 10a), the centrifugal force 19 to operate upon the globes 13 is less than that in a high-speed rotation, so it is difficult that the globes 13 move in such a direction as to cancel the unbalance. Furthermore, the leaked magnetic flux 24 from the magnet 27 is so great that, during the high-speed rotation as shown in Fig. 10b, the globes 13 cannot move beyond the magnetic flux barrier 24a, and thus cannot cancel the unbalance.

In comparison with the above, when the polarization in a radial or axial direction is carried out, the leaked magnetic flux 24 is so little that the above-mentioned problems can be solved. In addition, the leaked magnetic flux 24 exists in the entire periphery of the magnet 27 so

homogeneously that the magnetic flux barrier 24a like in the above-mentioned dipole magnetization (Fig. 10b) does not occur, and the globes 13 therefore can smoothly move in a circumferential direction.

Incidentally, the use of the magnetization technique by the polarization in an axial or radial direction, according to the present invention, gives the same effects as those of the aforementioned embodiment of the quadrupole magnetization of Fig. 2 (A).

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 includes: (a) a side section of the vicinity of an spindle motor and (b) a plan of a magnet for a disk apparatus according to an embodiment of the present invention.

Fig. 2 includes graphs to compare the timing between the movement of globes and the read starting.

Fig. 3 is a side section of the vicinity of an spindle motor of a disk apparatus according to another embodiment of the present invention.

Fig. 4 is a side section of the vicinity of an spindle motor of a disk apparatus according to another embodiment of the present invention.

Fig. 5 is a horizontal section of a clamper in the apparatus of Fig. 4.

Fig. 6 includes schematic perpendicular sections of clampers in the apparatus of Fig. 4.

Fig. 7 is a perspective of a conventional disk apparatus.

Fig. 8 is a side section of the vicinity of an spindle motor of the conventional disk apparatus having a balancer.

Fig. 9 is a horizontal section showing the function of the balancer in the conventional disk apparatus.

Fig. 10 includes horizontal sections showing influences of the leaked magnetic flux to globes in a dipole-magnetized disk apparatus.

INDUSTRIAL APPLICATION

As is mentioned above, the disk apparatus, according to the present invention, can realize a disk apparatus which can stably replay and record data even when rotating an unbalanced disk at a high speed, and can prevent the unnecessary noises from occurring during the low-speed rotation like in the audio play mode, and further can prevent the occurrence of errors, such as read errors and spinning-up time over, by hastening the timing of the collision of the globes with the magnet or tumbling face during the rapid change of the number of rotations, or by suppressing the impact due to such collision.

CLAIMS

1. A disk apparatus, comprising: a balancer, which is set to rotate in one body with a fitted disk and has a hollow ring-shaped part containing a magnetic matter; and a magnetic-field-generating means for holding the magnetic matter by suction;

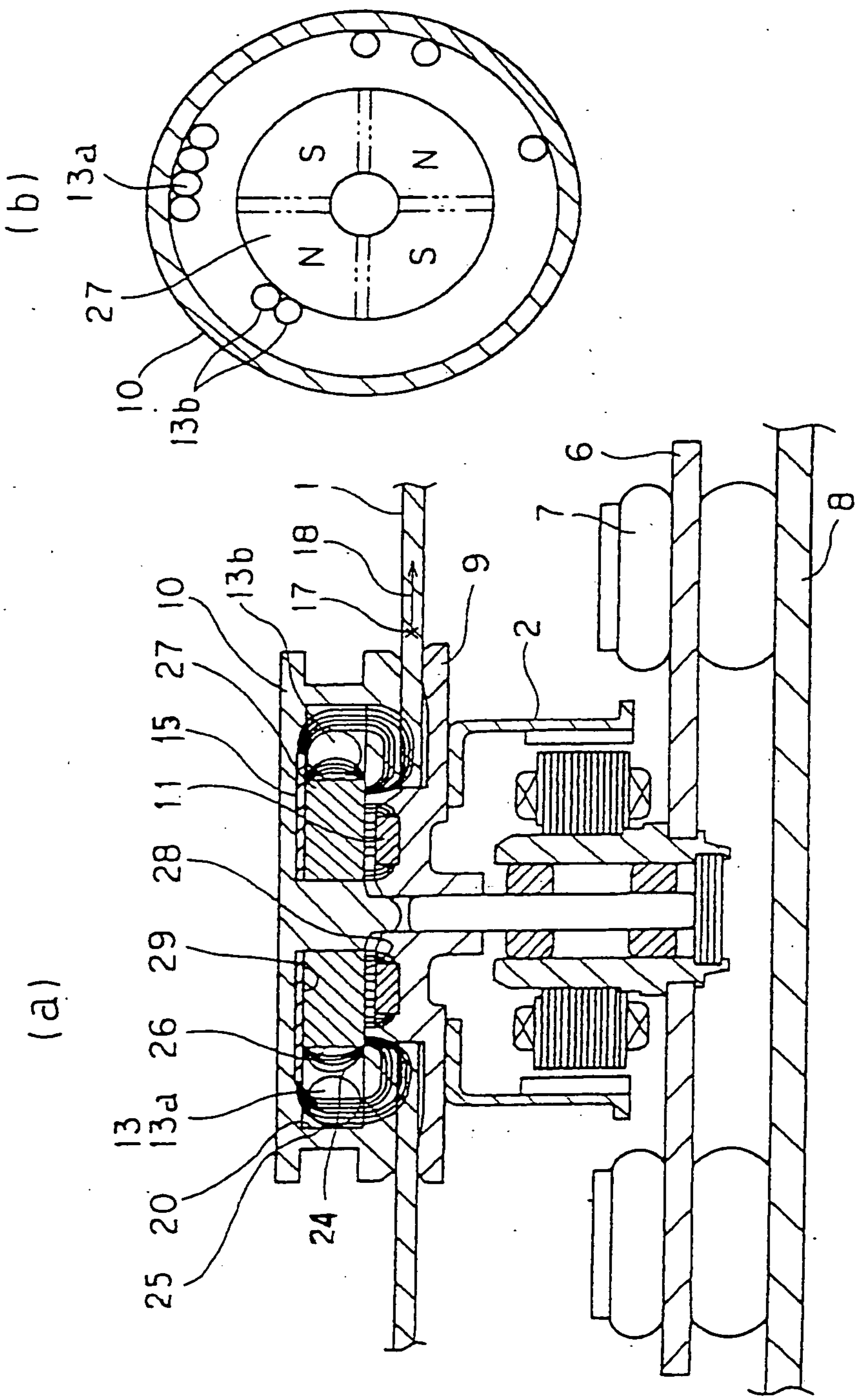
wherein the magnetic-field-generating means is a magnet which is placed on the inner peripheral side of the hollow ring-shaped part and is magnetized by polarization into four or more poles in a rotational direction.

2. A disk apparatus, comprising: a balancer, which is set to rotate in one body with a fitted disk and has a hollow ring-shaped part containing a magnetic matter; and a magnetic-field-generating means for holding the magnetic matter by suction;

wherein the magnetic-field-generating means is a magnet which is placed on the inner peripheral side of the hollow ring-shaped part and is magnetized by polarization in a direction of a rotational axis.

3. A disk apparatus, comprising: a balancer, which is set to rotate in one body with a fitted disk and has a hollow ring-shaped part containing a magnetic matter; and a magnetic-field-generating means for holding the magnetic matter by suction;

wherein the magnetic-field-generating means is a magnet which is placed on the inner peripheral side of the hollow ring-shaped part and is magnetized by polarization in a radial direction.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13a
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25
20
24
13
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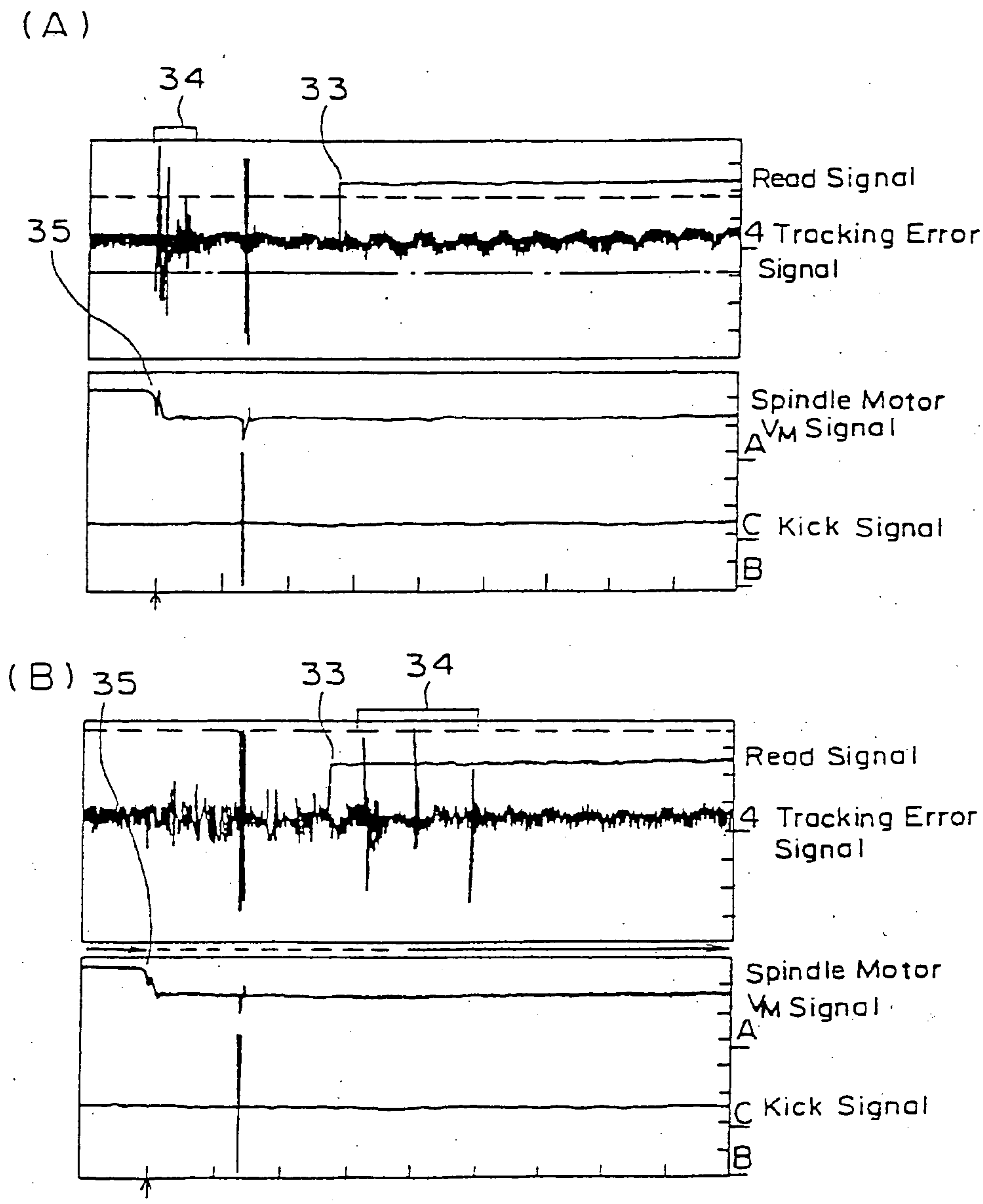
Fig. 1

Fig. 2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35
Read Signal
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Spindle Motor V_M Signal
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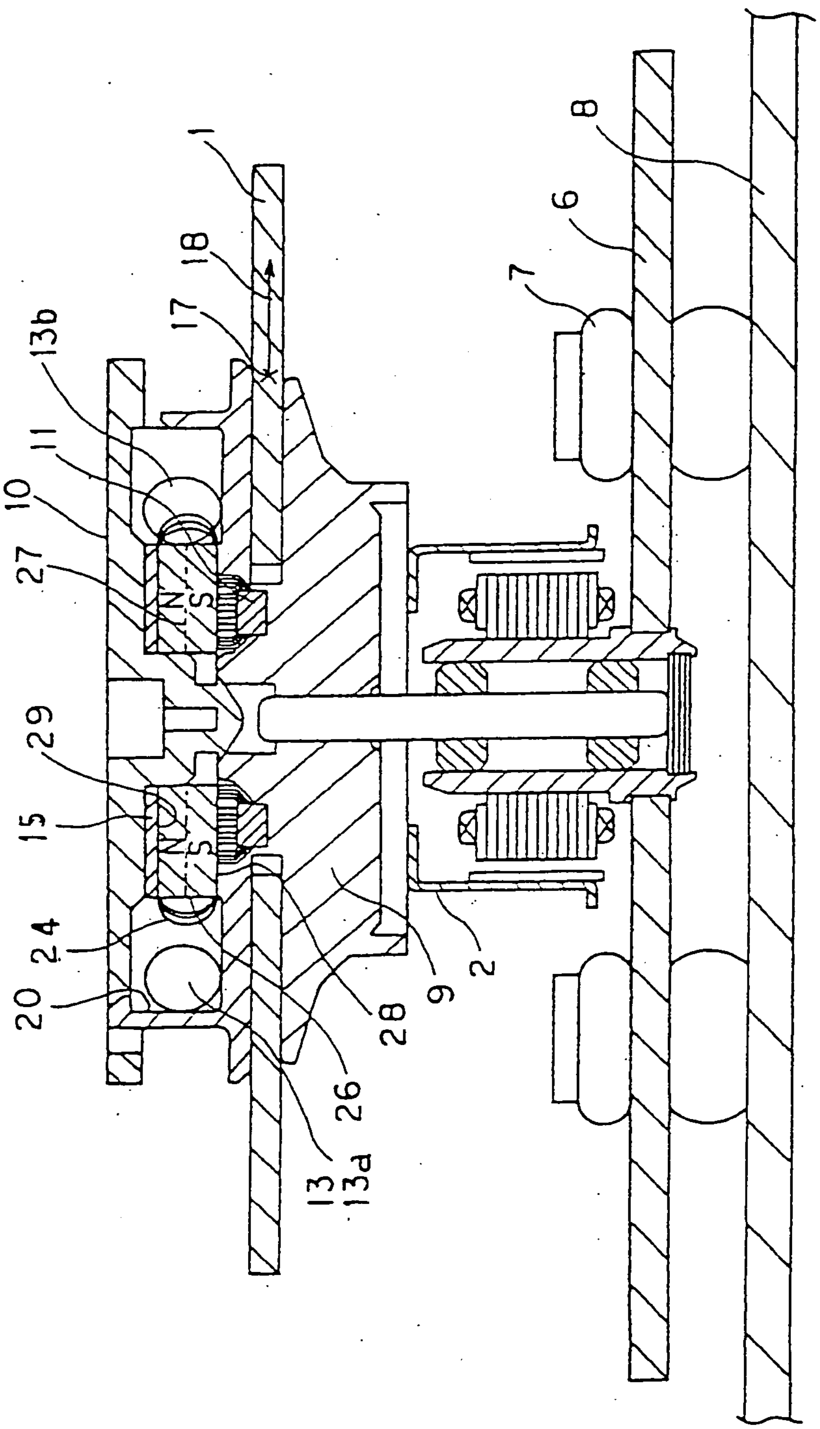


Fig. 3

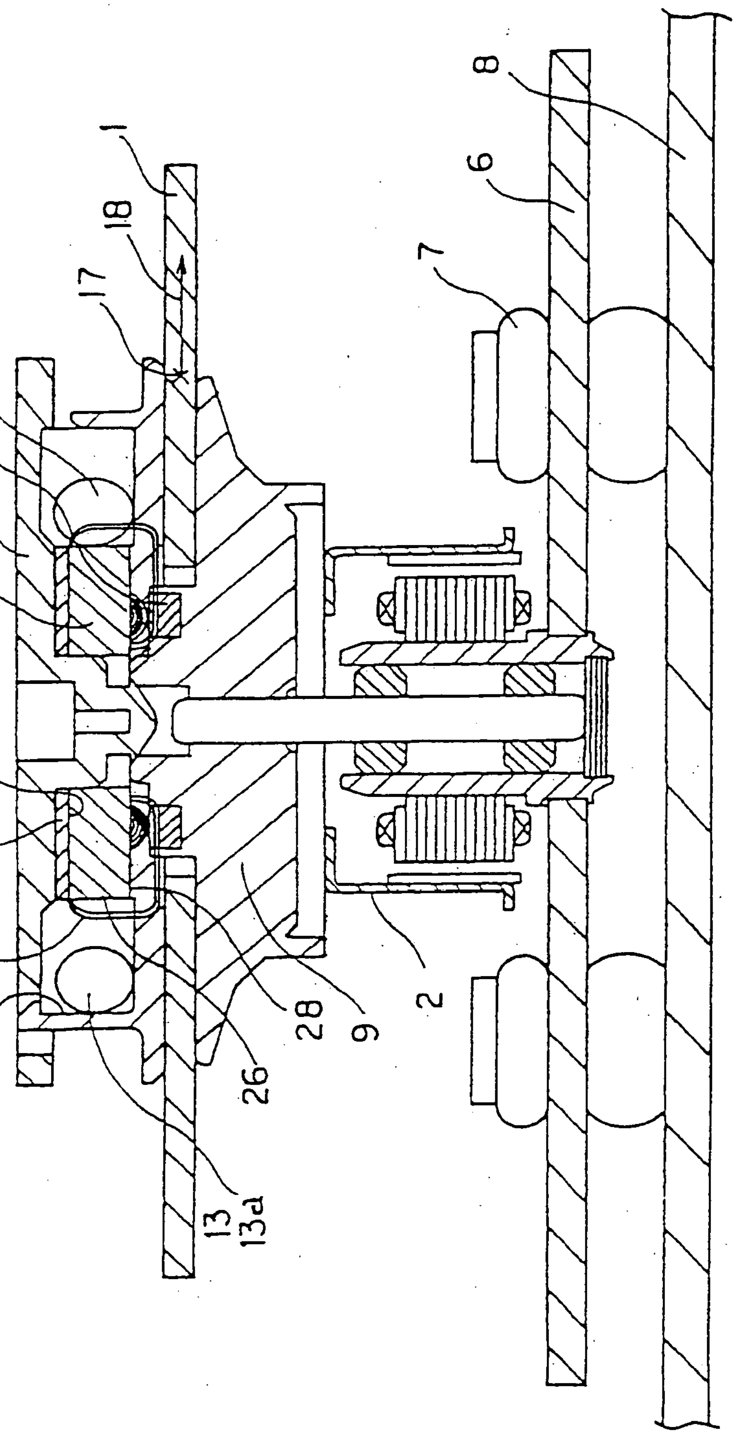


Fig. 4

Fig. 5

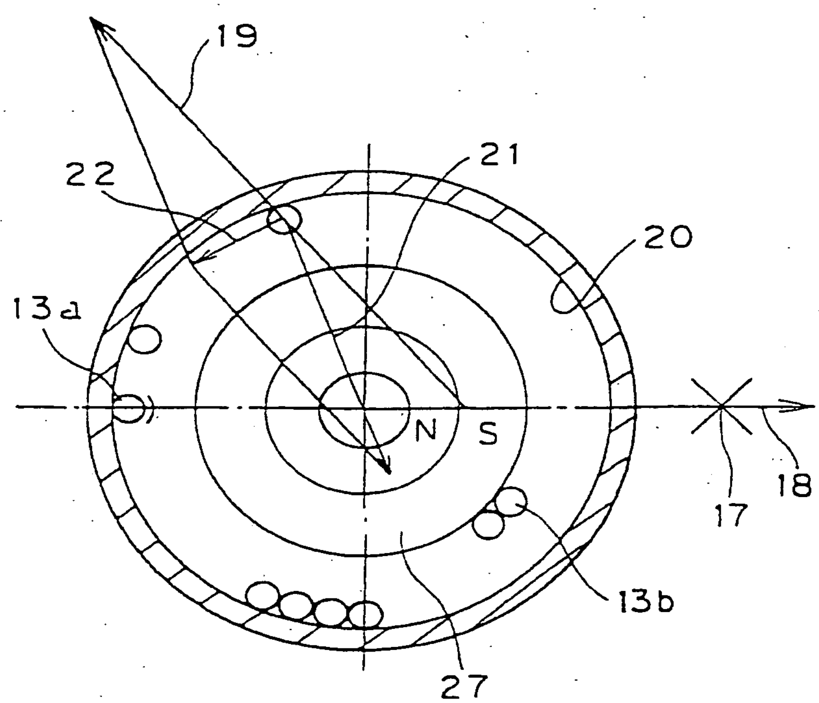
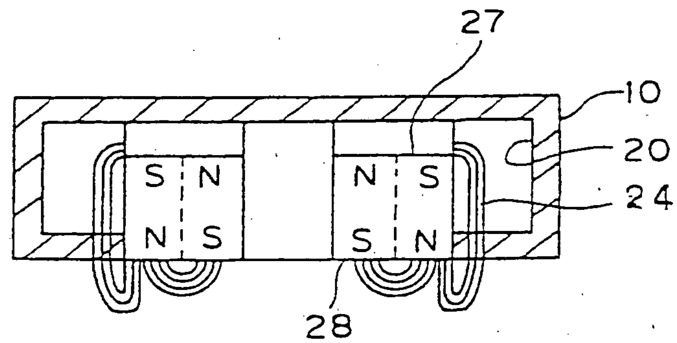


Fig. 6

(a)



(b)

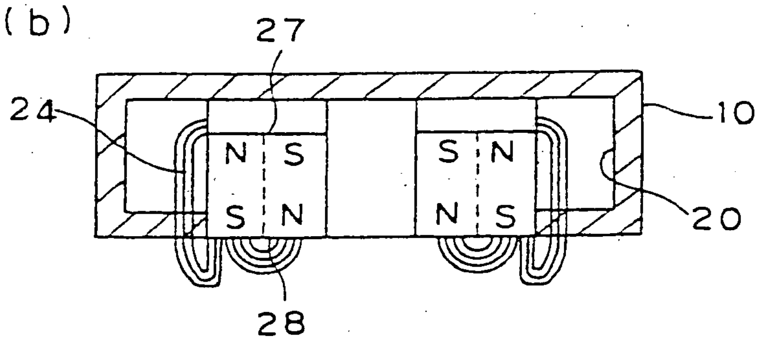
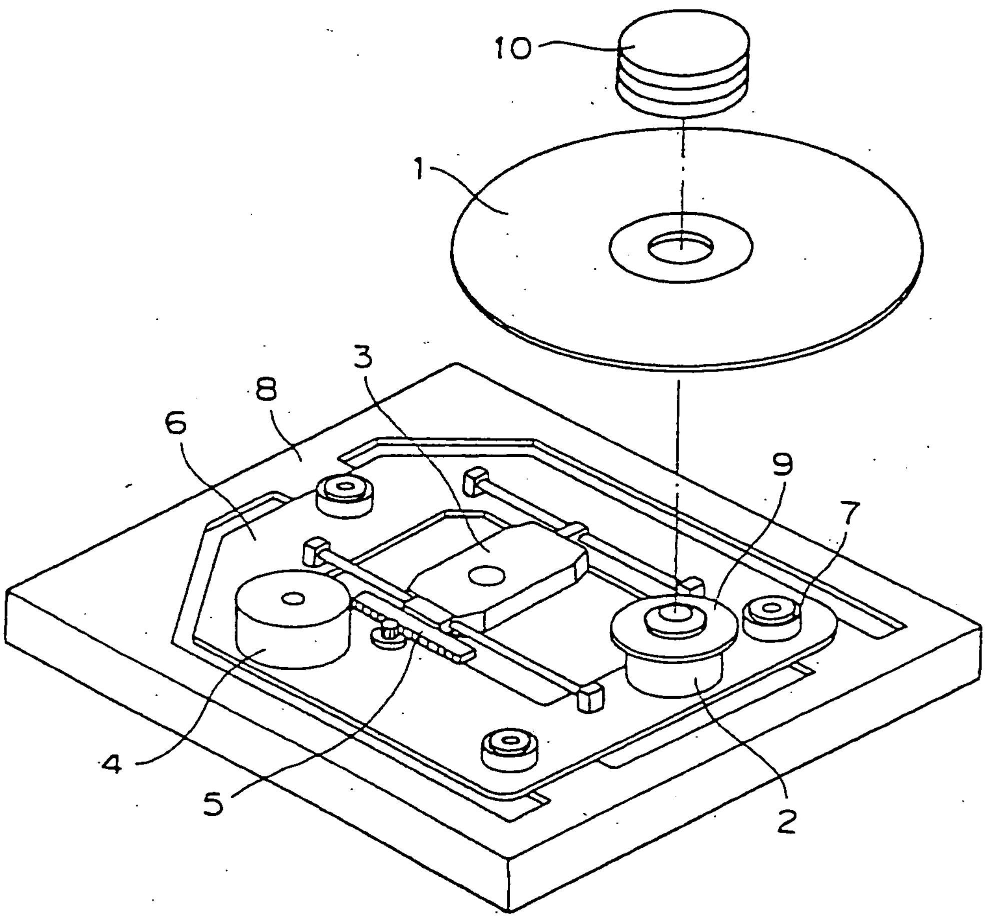


Fig. 7



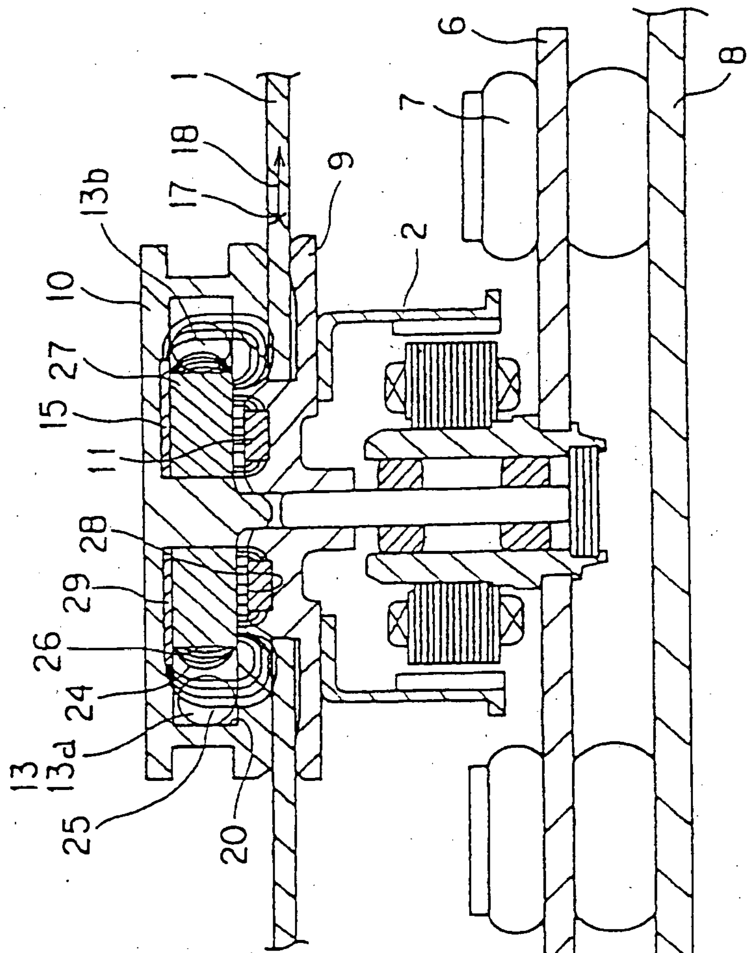


Fig. 8

Fig. 9

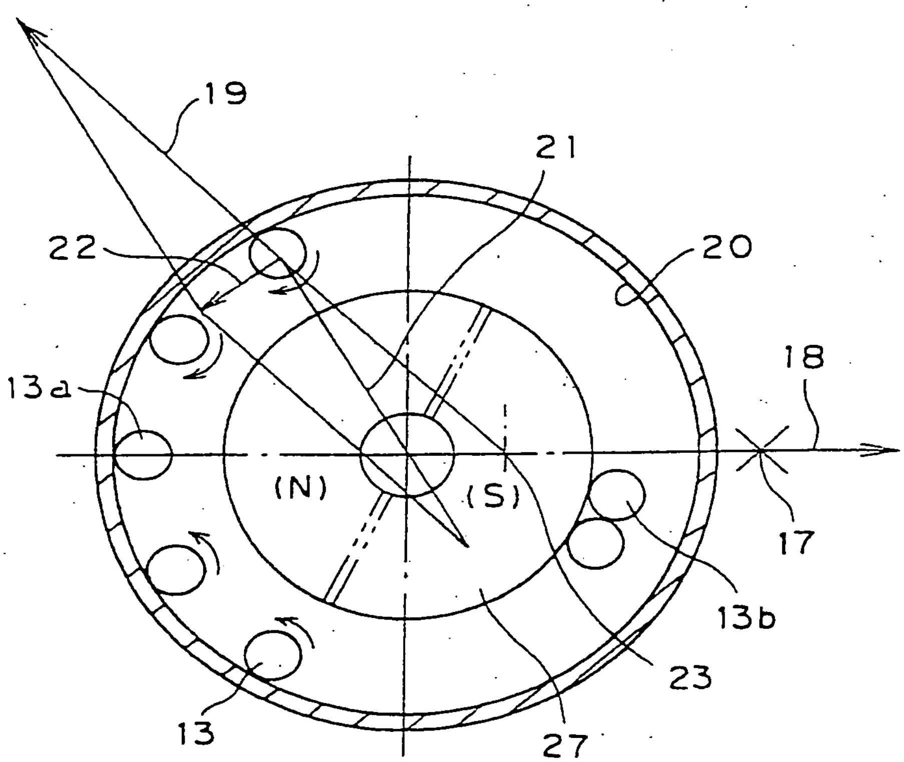
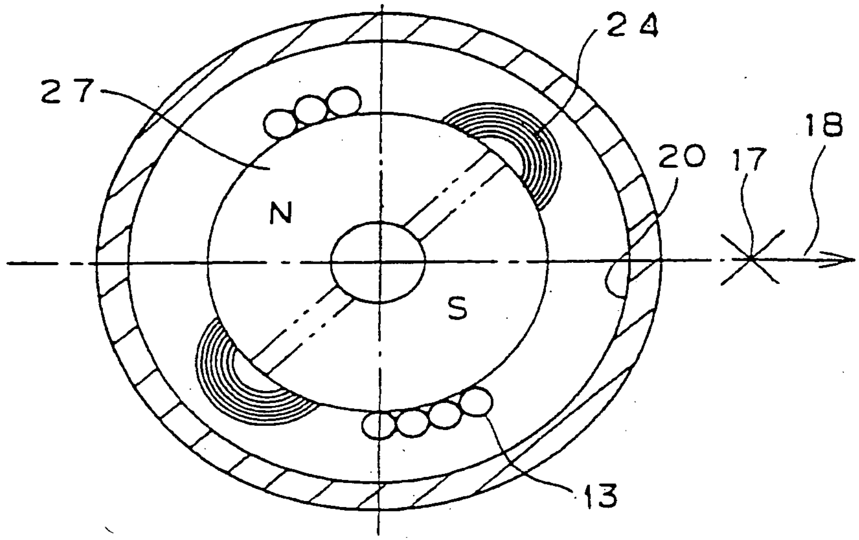


Fig. 10

(a)



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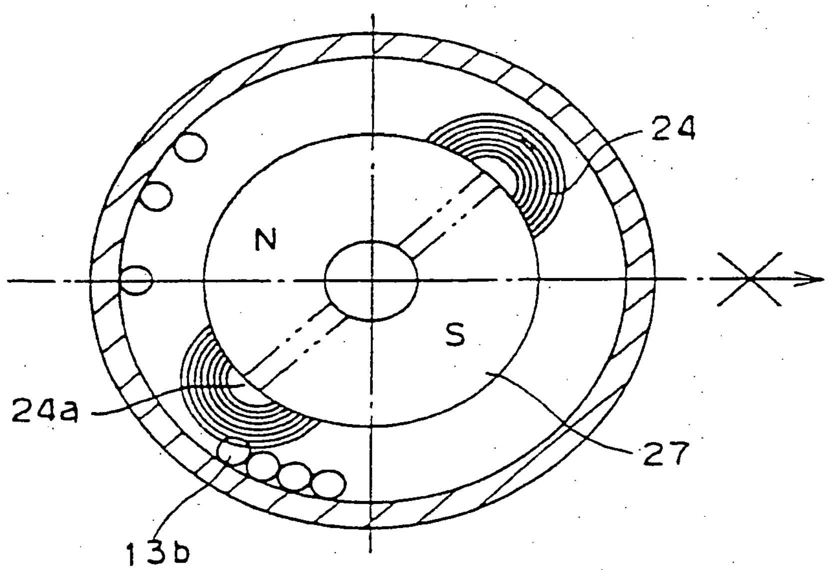

INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 99/03702

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G11B19/20 H02K7/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G11B H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	EP 0 938 087 A (THOMSON BRANDT GMBH) 25 August 1999 (1999-08-25) claims 1,4,6,7,11,15,16; figures 12-15 column 19, line 11 -column 20, line 50	1-3
X	WO 98 03974 A (FUKUYAMA SACHIO ;MASAKI KIYOSHI (JP); MIHARA KAZUHIRO (JP); URAYAM) 29 January 1998 (1998-01-29) abstract; figures 16-18	1-3
A	EP 0 836 185 A (SAMSUNG ELECTRONICS CO LTD) 15 April 1998 (1998-04-15) the whole document	1,2
A	EP 0 829 872 A (HITACHI LTD) 18 March 1998 (1998-03-18) the whole document	1,2

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 October 1999	05/11/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Benfield, A

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/JP 99/03702

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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WO 9803974 A	29-01-1998	JP 2824250 B	11-11-1998
		JP 10083622 A	31-03-1998
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Fig. 1

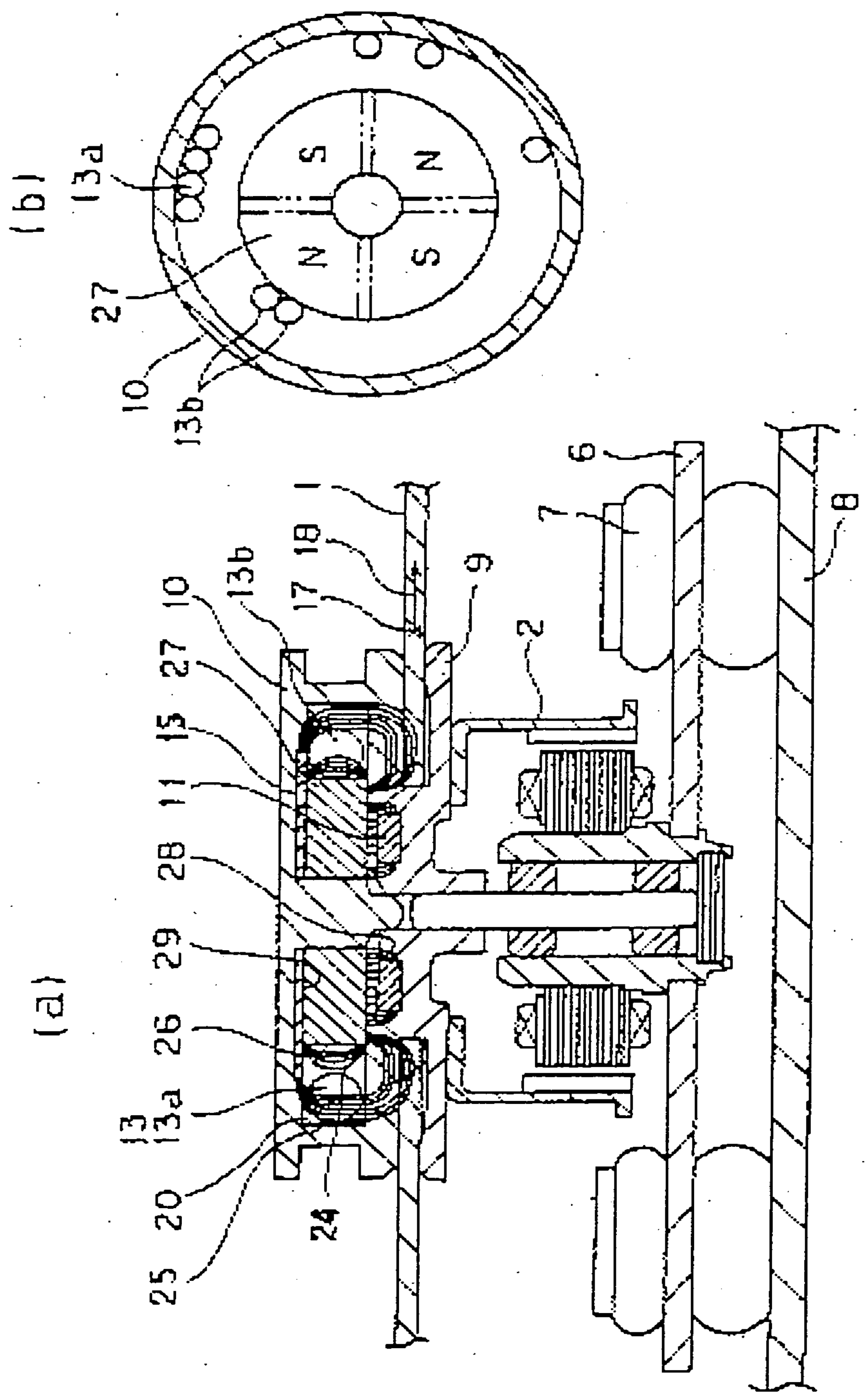
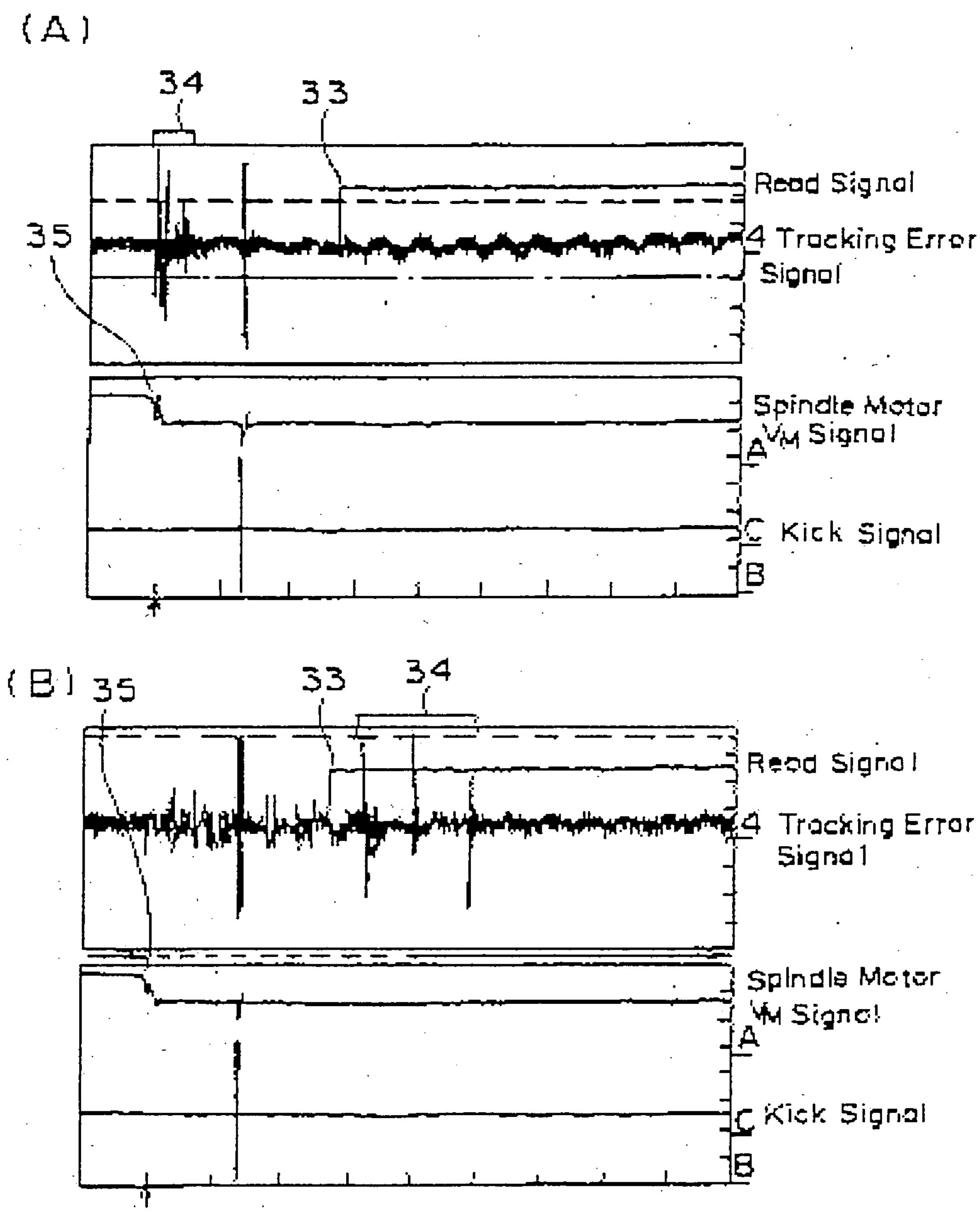


Fig. 2


(A)
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33
35
Read Signal
4 Tracking Error Signal
Spindle Motor V_M Signal
A
C Kick Signal
B
(B)
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Read Signal
4 Tracking Error Signal
Spindle Motor V_M Signal
A
C Kick Signal
B

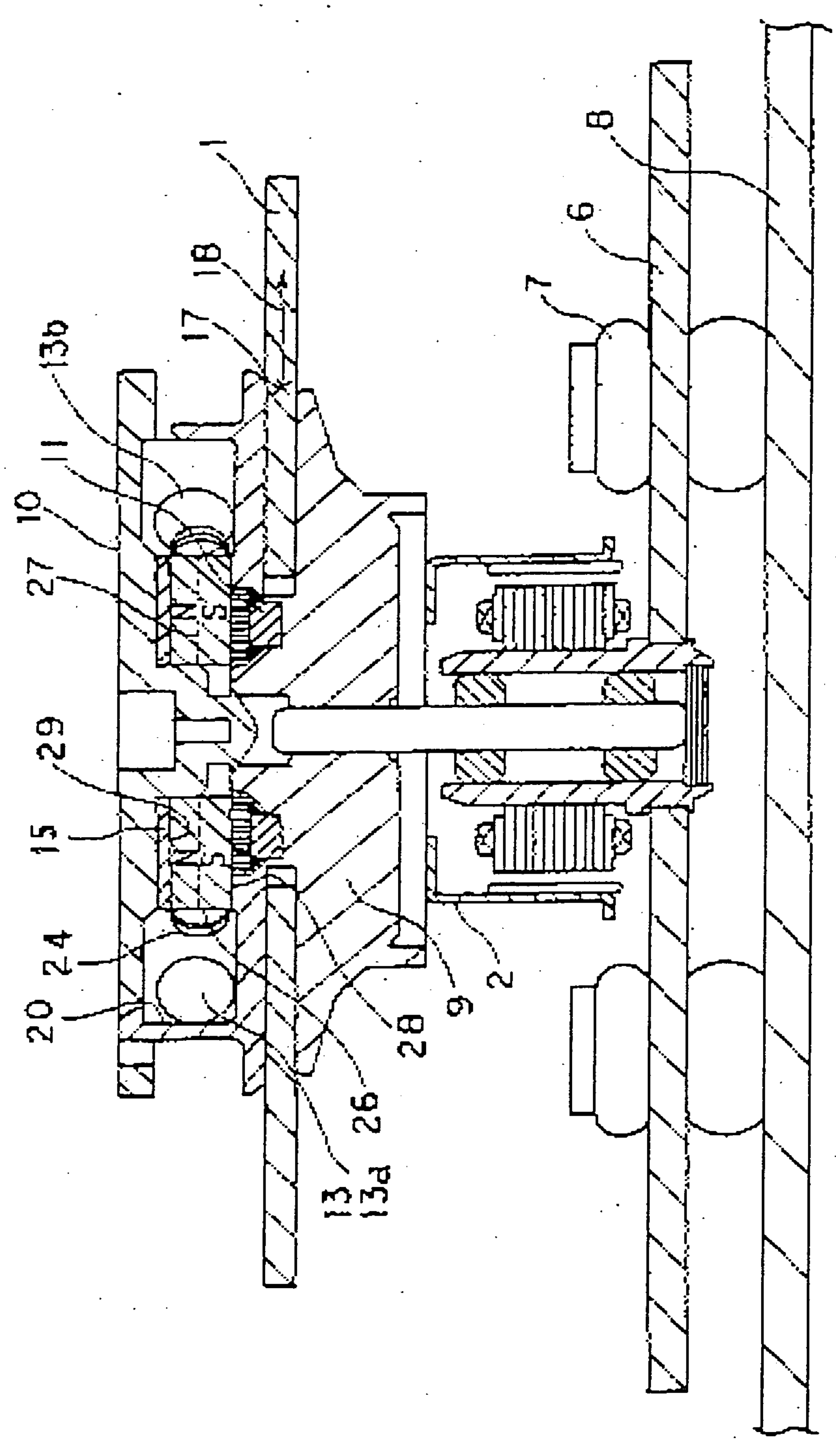


Fig. 3

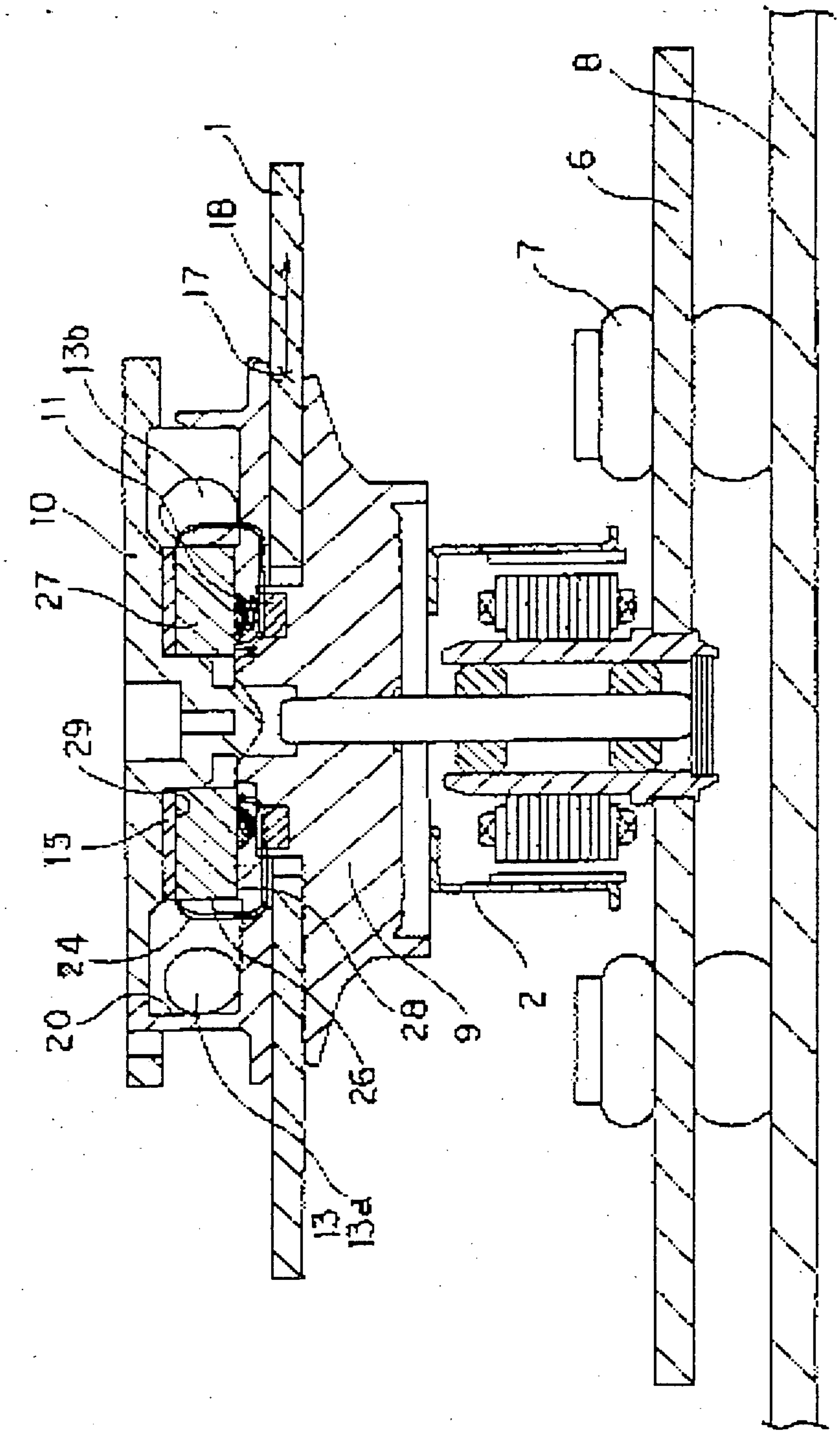


Fig. 4

Fig. 5

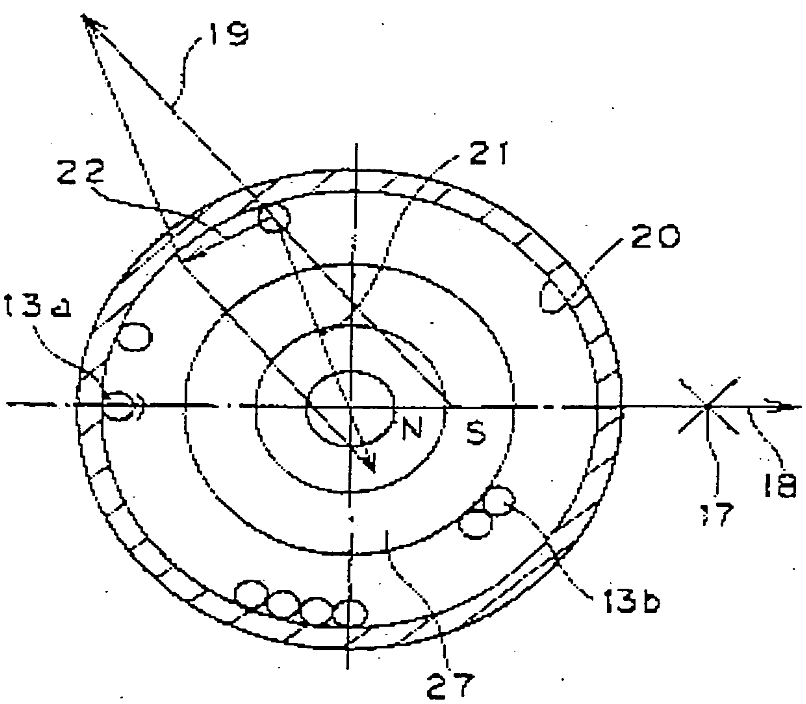
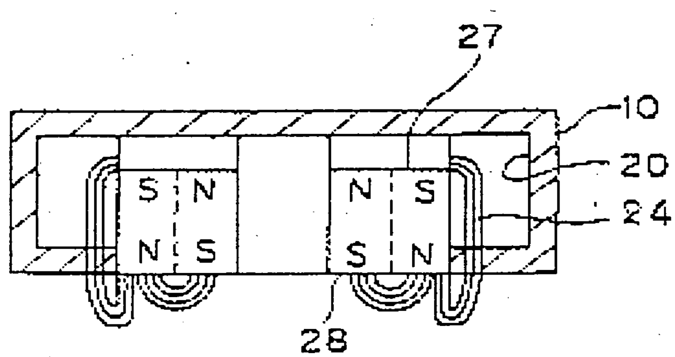


Fig. 6

(a)



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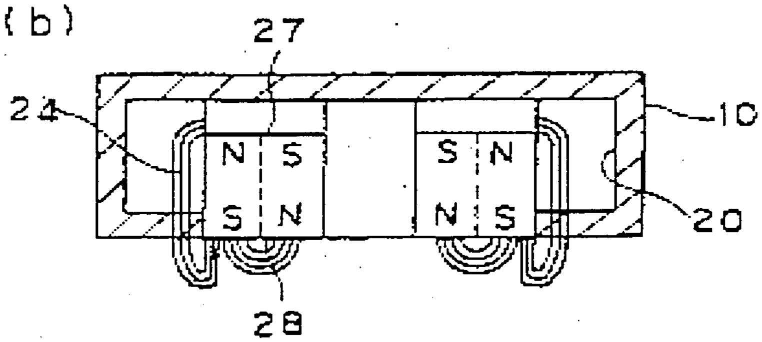
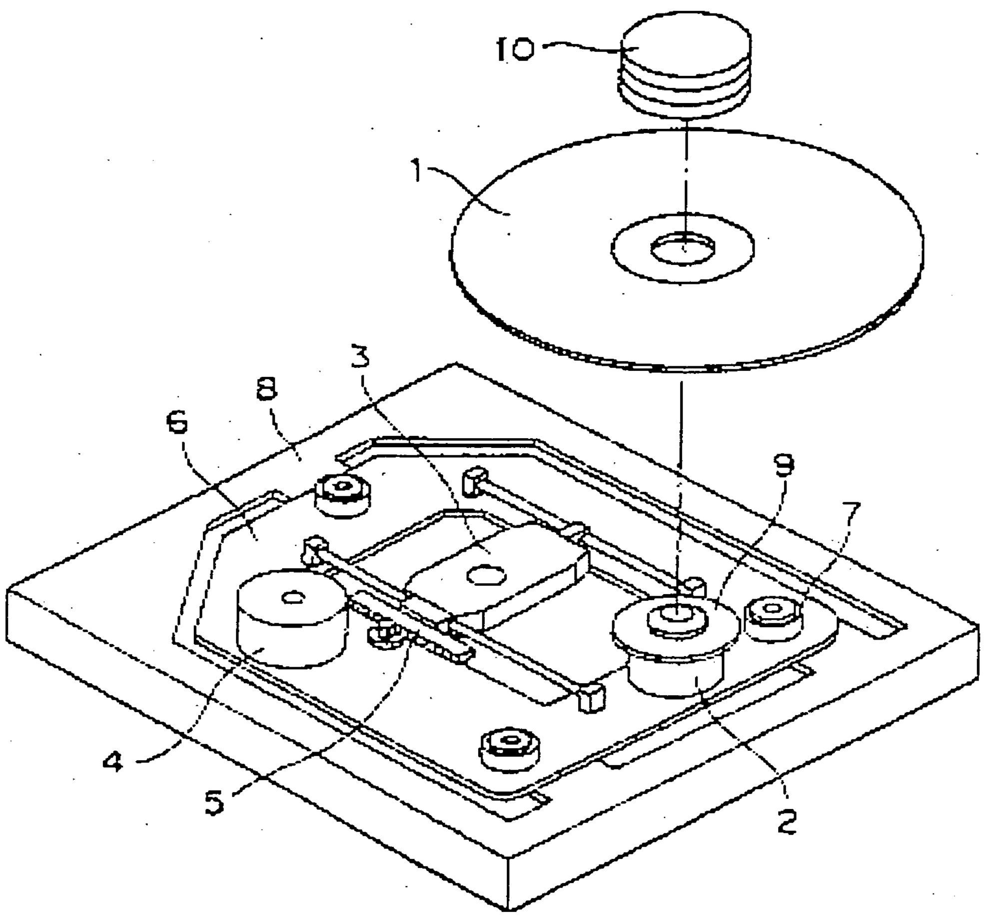


Fig. 7



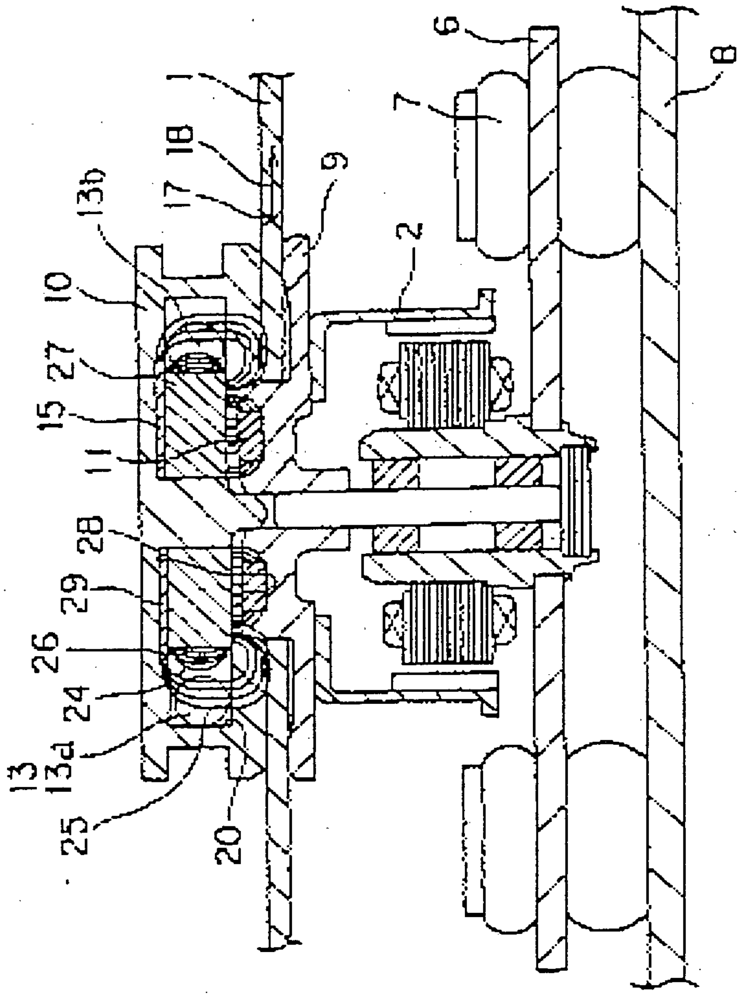


Fig. 8

Fig. 9

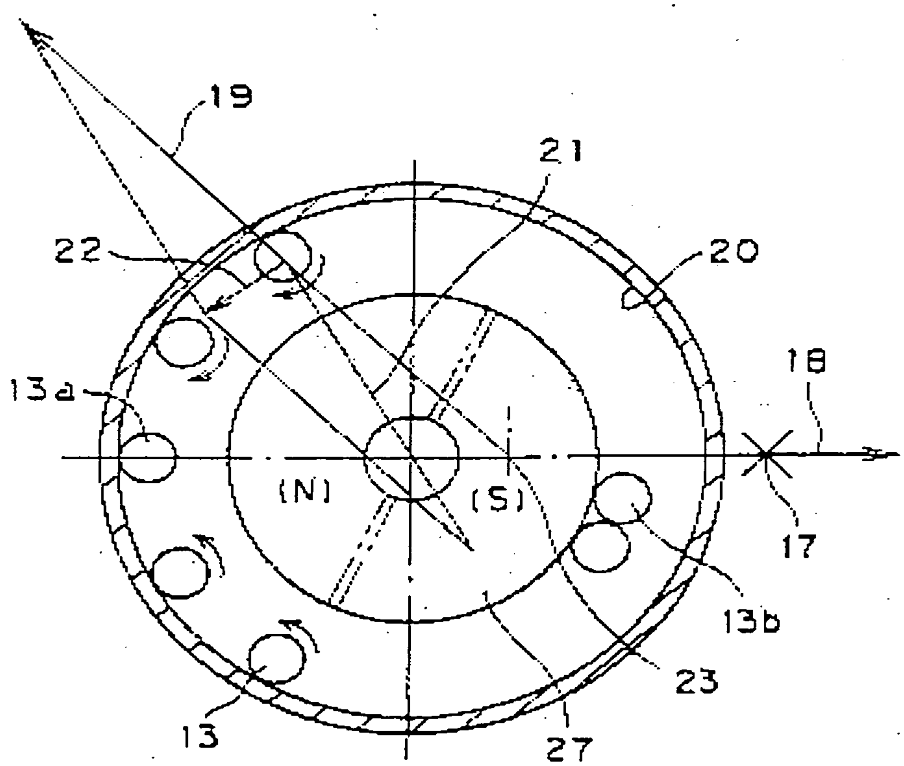


Fig. 10